Technical Report

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Coal Water Fuel Derating Assessment for The Front Wall-Fired Oil Design Boiler No. 10, Maritime Electric Company Charlottetown, P.E.I.

by

R.P. Viscardi
Babcock & Wilcox Canada

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EXECUTIVE SUMMARY

The intent of the study was to determine the maximum allowable evaporation rate for the Maritime Electric Company No. 10 boiler, while firing a specific coal-water slurry known as CARBOGEL. All evaporation rates while firing the CWS are stated as a percentage of the original oil fired maximum continuous rating (MCR) for the boiler.

This unit is characterized by a very "tight" oil fired design, consisting of a small compact furnace and a convection pass with closely spaced tubes. The design of this small bottom supported unit is not conducive to the burning of a coal based fuel.

The use of Babcock & Wilcox's computer modelling technique was used to predict the heat transfer in the convection pass. Calculations based on using known B&W parameters for the parent pulverized fuel (there are no specific parameters for CWS) have shown that the unit could operate at 32% MCR while firing CWS. This figure is based on remaining within the boundaries of BW recommended standards. This is a nominal value and may vary with small changes in performance parameters. The following major points summarize the results of the study.

EXECUTIVE SUMMARY (cont'd.)

1. The major constraint of the unit in its present configuration is the very closely spaced superheater tube side spacings. The 1" face to face clearance of the secondary has limited maximum allowable gas temperature to 1300°F (704°C). Working backwards an acceptable furnace exit gas temperature (FEGT) was found which correspond to a maximum evaporation rate of 32% MCR.

2. Other design parameters such as plan area heat release rate, gas velocity, furnace liberation rate, and input per burner are all greater than the tube spacing restraint and as such do not come into play.

3. The study was based on having the inclined portion of the existing furnace screen sealed with refractory tile. It is felt this is necessary to prevent excessively hot gases by-passsing the secondary superheater. This could cause severe plugging of primary superheater surface, and it would also not be possible to accurately predict superheater heat transfer with the computer model.

4. The low ash content (1.7%) of the CARGBOGEL CWS, will result in about 600 pounds (272 Kg) of ash accumulation per day on the furnace floor, at the 32% load. This accumulation must be removed through the use of a manual method such as an ash rake through a lower door. It is not recommended that fuels with high ash content be fired due to the inefficient ash removal situation.

5. The 6 G9B sootblowers located in the generating bank were deemed acceptable. The 2 IK blowers located in the cavity between secondary and primary superheaters, are not recommended for use with the existing superheaters and the firing of CWS. It is also recommended that an additional blower per side such as short retractable IR blowers be installed at the mid point of the furnace cavity in front of the vertical furnace screen.

6. An alternate superheater/furnace screen combination has been suggested . Due to the wider tube spacings, this combination would allow firing up to 57% MCR with a minimum of 38% MCR in order to maintain steam temperature. The new range of oil firing would be from 46% MCR to 100% MCR. A graphical representation of boiler performance with existing and alternate superheaters is shown in Figures 2 to 5 inclusive.

INTRODUCTION

Many oil fired power boilers have become economically unfeasible to operate continuously. Coal-water slurry (CWS) is an alternative to oil which has potential. The level of potential or feasibility of CWS is dependent on such major factors as existing boiler configuration and individual CWS characteristics. The firing of a coal based fuel in an oil designed boiler requires boiler output to be reduced to an acceptable level which will coincide with the allowable coal performance characteristics.

The attractiveness of CWS for use in oil fired boilers stems from the fact that CWS is fired much in the same manner as oil. Unlike pulverized coal firing, CWS does not does not require very large capital expenditures for auxiliary equipment such as pulverizers, associated piping, and other process required equipment. CWS can be delivered, stored and pumped much like oil. The slurry generally consists of approximately 70% coal and 30% water, with some variations on the percentages.

STUDY OBJECTIVES & LIMITATIONS

The purpose of this study has been to determine to what level the oil fired No. 10 boiler at Maritime Electric Company, Charlottetown, P.E.I. would have to be derated for firing coal water slurry. Also included in the scope of study is suggested possible changes to the boiler to decrease the severity of deration. The study is based on firing only one type of CWS, that is CARBOGEL CWS.

Actual laboratory burn tests for an almost identical coal have been done in Ref. 2. The results of this test have been reviewed and examined for any possible changes to the Babcock & Wilcox performance parameters. The review did not have an impact on the parameters involved.

No attempt was made to determine the economic feasibilty of firing at the derated level, or of any suggested changes. The use of Babcock & Wilcox's computer modelling technique was used to arrive at the derated levels.

ASSUMPTIONS

Boiler

1. No attempt to determine the size, quantity or type of burners required to fire CWS has been made. Any performance data based on burner details has been assumed to be similar to existing B&W P.C. burner information.

2. Detailed changes to the boiler for the removal of ash have not been addressed. It is assumed the Customer has addressed the issue of ash removal required for any test burns.

3. Details of any necessary changes to boiler structural steel, flue or duct stiffening or routing are not included.

4. The unit deration calculations are initially based upon making no changes to the boiler pressure parts. Calculations have also been done for a suggested alternative convection pass.

FUEL

1. It is assumed that slurrying would have no effect on the ash fusion temperature or slagging/fouling tendencies of ash chemistry of the parent coal.

2. It is also assumed that the benification of the coal would have no effect on the ultimate analysis of the coal ash during CWS firing.

3. This study is based upon the fuel supplied by CANMET,known as CARBOGEN, and summarized following elsewhere in the report.

PERFORMANCE

1. In view of the fact that Babcock & Wilcox does not have specific design parameters for the firing of CWS, the following parent PC design criteria has been used as a basis for all calculations.

   (a) Burner zone heat release rate
   (b) Plan area heat release rate
   (c) Furnace exit gas temperature

PERFORMANCE (cont'd.)

(d) Furnace volume liberation rate

(e) Flue gas velocity

(f) Allowable gas temperature vs tube spacing

(g) Convection surface cleanliness factors

2. The level of air preheat varies with individual CWS and type of burner/atomizer used, but has been determined to be in the neighbourhood of 500°F (260°C).

3. No consideration has been given to the effect of the atomizing medium (probably air) used for CWS firing, on the performance of the unit.

BOILER REQUIREMENTS FOR CWS COMBUSTION

The major differences between an oil fired and coal fired boiler is the size. For a given output, an oil fired boiler will be "tighter" than a coal unit, that is to say the oil unit will have less furnace radiant surface and approximately half the convective tube spacing.

The following is a compilation of design features inherent in a coal or CWS unit:L

1. Furnace Size

The furnace must be designed with sufficient volume to

i) provide adequate furnace residence time for complete carbon burnout.

ii) provide adequate exposure of the hot gases to cold surface, so as to cool the ash/slag to an acceptable level before it reaches convective surface.

BOILER REQUIREMENTS FOR CWS COMBUSTION (cont'd.)

2. Burner Spacings

Sufficient burner centreline spacing and burner to water cooled surface spacing must be provided to limit furnace slagging to acceptable limits.

3. Convection Tube Spacings

Allowable gas temperature entering a given bank is determined from the tube face to face clearance and the fouling classification of the coal being fired.

4. Lower Furnace Design

The bottom of the furnace should be equipped with a hopper of slope 55°F. The hopper is required to funnel ash and slag into an ash pit for automated removal. The hopper also serves the purpose of reducing pressure part damage due to falling slag.

5. Sootblowers

Sootblowers should be placed as needed in both the convection pass and the furnace.

SPECIAL CONSIDERATIONS FOR FIRING CWS

The most apparent parameter to affect the firing of CWS will be the approximately 30 percent water in the fuel. The water has several effects. Due to the latent heat of evaporization of the water, it will require higher air pre-heat temperatures to offset some of the loss of heat to evaporization. As a result, for a given output more fuel is required due to the greater losses in unit efficiency. Measured flame temperatures can be 200-400^{o}F (93-204^{o}C) lower than the parent pulverized coal flame. These lower flame temperatures mean the furnace residence time will go up slightly because it is directly proportional to gas density. Low flame temperatures reduce carbon burnout, while long furnace residence time improves carbon burnout. These firing characteristics of CWS apply to most mixtures, but it must be stressed that individual slurries can vary with respect to, the level of air pre-heat, required amount of atomizing air, type of atomizer used, flame stability, and flame temperature achieved.

SPECIAL CONSIDERATIONS FOR FIRING CWS (cont'd.)

It should be noted that this study does not deal with any specific firing parameters involved with the burner design and possible variations for achieving a desired flame type or stability.

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COAL WATER ANALYSIS

Ultimate Analysis	As Fired Basis % By Wt.
Carbon	59.4
Hydrogen	3.96
Nitrogen	0.88
Sulphur	0.62
Oxygen	3.42
Ash	1.7
Moisture	30.0
Total	100

Heat Value	
H.H.V.	10,500

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COAL WATER ANALYSIS

Ultimate Analysis	As Fired Basis % By Wt.
Ash Analysis	%
SiO_2	32
Al_2O_3	18
Fe_2O_3	42
TiO_2	0.9
CaO	1.7
MgO	0.8
P_2O_5	0.3
SO_3	1.5
MnO	0.2
Na_2O	0.9
K_2O	1.0
Undetected	0.7
Total	100

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COAL WATER ANALYSIS

Ash Fusion Temperatures

	Reducing	Oxidation
Initial Deformation	2030°F	2534°F

Slagging & Fouling

Base/Acid ratio	0.912
Rf	0.82
Rs (based on dry coal)	0.82
Slagging Classification	Medium
Fouling Classification	High

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BOILER SPECIFICATIONS

The unit is a two drum bottom supported Stirling Power Boiler, originally designed for pressurized firing of Bunker'C' (No.6) oil. Original specifications are as follows:

Steam	
Flow	190,000 pph
Temperature (@ S/htr.Outlet)	900°F
Pressure	875 psig
Drum Pressure	915 psig
Feedwater	
Flow	190,000 pph
Temperature	345°F
Pressure	931 psig
No. of Burners	5
Generating Bank	3 pass crossflow
Airheater	Ljungstrom Regenerative
SCAH	Unifin
F.D. Fan	Howden
I.D. Fan	-
Width & Depth	20' x 18.25'
Centreline to Centreline Drums	30'

TECHNICAL

The configuration of this oil fired boiler does not promote the firing of any coal based fuel. This boiler exhibits a typical oil fired design, but more extreme than large oil fired utility units. The unit is characterized by very closely spaced convection tubes, and a small compact furnace with burners in close proximity to the furnace exit screen.

With the unit in its present configuration, except for the addition of refractory tiles to seal the inclined portion of the screen,the most major constraint is the one inch (25.4mm) face to face clearance of the fifth row of the secondary superheater. This tube clearance has resulted in a maximum allowable evaporation rate of 32% of MCR (Maximum Continuous Rating) oil firing capability. Due to the gas temperature restraint in the secondary superheater, the furnace exit gas temperature is actually lower than screen spacing allows. An increased amount of wide space convection surface ahead of the superheater would cool the gases further allowing a lesser degree of deration.

TECHNICAL (cont'd.)

By increasing screen and superheater spacings a maximum evaporation rate of 57% MCR could be achieved, with almost coinciding limiting factors being available furnace surface area and superheater allowable gas temperatures. Furnace surface is just sufficient to allow maximum furnace exit gas temperature, while the gas temperature drop through the screen is sufficient to allow maximum gas temperature for the secondary superheater clear spacing.

This unit has a refractory covered flat floor not suited to the handling of ash resulting from firing CWS. Manual ash removal through access doors will be required and will hamper any prolonged firing.

Superheater metal checks have shown existing metals to be suitable at the low loads.

EXCESS AIR

Excess air levels for CWS firing were determined from B&W standards for PC firing. Required excess air may vary with burner characteristics, this study does not deal with any burner specifics,therefore excess air levels may be considered to be nominal values.

Based upon typical excess air levels used in Reference 2, it was decided to treat the maximum allowable firing rate for CWS as MCR conditions for that fuel, consequently, excess air at the burners is based on B&W's recommended level for PC firing at MCR. Any additional excess air to the boiler from infiltration was determined by pro-rating the MCR infiltration values using the load percentage. This method is expected to give excess air levels which are close to actual.

GAS TEMPERATURE VS. SIDESPACING

The unit has been originally designed with non uniform pitch side spacing and back spacing for the superheaters. The most critically affected with regards to gas temperature is the secondary. The secondary uses 2 inch (50.8 mm) OD tubes. The first four rows of depth are side spaced on 6 inch (152.4mm)centres, the fifth through ninth rows are on 3 inch (76.2 mm)centres. Babcock & Wilcox standards for allowable gas temperature vs. side spacing, dictate that maximum gas temperatures for a 1 inch (25.4 mm) face to face clearance should be 1300°F (704°C).

The furnace screen consisting of two rows of 3 inch (76.2 mm) OD tubes on 6 inch (152.4 mm) centres, dictates a maximum allowable furnace exit gas temperature (FEGT) of 1650°F (900°C).

Computer predicted heat transfer across the screen tubes and first four rows of secondary superheater is not great enough to sufficiently cool the gas from 1650°F (900°C) to approximately 1300°F (704°C) entering the fifth row of the secondary. As a result of this FEGT is limited to about 1560°F (850°C).

UNBURNED COMBUSTIBLE LOSS

Unburned combustible loss can be affected by flame temperature, furnace residence time and furnace absorption. Boilers designed exclusively for oil, as is this unit, have higher release rates and shorter residence times than those designed for coal. Lower flame temperature for CWS,anywhere from 200 to 400^{o}F (93-204^{o}C), raise unburned combustible loss. Since residence time is a function of gas density the lower temperatures can increase gas residence time slightly over those for oil firing. Since furnace absorption is a function of temperature to the fourth power, we can easily appreciate the lower CWS furnace adsorption.

Due to the 30% moisture content of the as fired fuel and unavailability and unknown applicability for values of percent through a #200 mesh, it was felt that the B&W method for UCL based on PC would not be suitable. A nominal value of 2.5% was used. Burn tests performed in Reference 2 for an almost identical fuel has shown carbon loss to be typically in the range of 2-3% (based on CO_2 measurements). The actual value will vary with the amount of furnace absorption, level of air preheat and burner/atomizer characteristics.

DESIGN LIMITS

Boiler design limits for this unit are shown in Table 1. Several of the furnace design parameters are not within the B&W recommended limits, specifically furnace liberation rates, height of top burner to bottom of furnace arch, a missing ash hopper and transverse distance from top burner to top of arch. Neglecting the lack of ash hopper, the furnace parameters could theoretically allow the boiler to be fired to a maximum of 78% of its capacity. The actual allowable firing rate of 32% MCR is due to convection pass restraints. There is not enough room in the convection pass for modifications to allow a firing rate of 78% without severely affecting steam temperature and/or steam production capacity. A graphical illustration of design parameters versus allowable load is shown in Figure 1.

TABLE 1

Parameter	Actual @ MCR CWS Firing	Allowable	% of MCR Attainable
Heat Release /Plan Area (MK_2BTU/Hr. ft.	723.13	806.3	100
Furnace Liberation Rate (KBTU/ Hr. ft^3	34.84	27	78
Gas Velocity (ft./sec.	44	65	100

TABLE 2

Furnace Dimension	Actual	Recommended (min)
Sidewall Clearance (ft.)	5.5	4.1
Height to Top of Hopper (ft.)	-	8.0
Height to Bottom of Arch (ft.)	3	4
Transverse Distance, Top Burners to Tip of Arch (ft.)	13	16
Furnace Depth (ft).	18	16

ASH

This unit has a relatively flat floor (3 deg.) and will require a very low ash coal due to ash removal problems. The CARBOGEL fuel does fit this requirement, having only 1.7% ash on an as fired basis.

At the derated loads of 32% it is expected that a little over 600 pounds (272 kg) of ash will accumulate on the furnace floor per 24 hour period. This estimate is based on a typical furnace ash retention value of 20% at low loads. With the alternate superheater installed and operating at 57% MCR a furnace ash accumulation of over a half a ton (454 Kg) could be expected per 24 hours. A manual method using an ash rake through a lower furnace door could be suitable for removing this ash during burn tests. Excessive amounts of ash and slag should not be allowed to accumulate within the boiler due to reduced heat transfer causing FEGT to rise. Lower flame temperatures encountered in CWS firing could make furnace cleaning easier because of a lesser degree of ash sintering.

ASH

The closing of the inclined portion of the screen through the use of refractory tile or screen replacement will form a hopper shaped cavity at the base of the superheater. This cavity will require periodic manual ash removal in order to maintain expected superheater performance.

The unit will require the installation of a baghouse type filtering device, or other suitable equipment for removal of ash from the flue gas.

AIR PREHEAT AND ASSOCIATED EQUIPMENT

Due to the 30% moisture of CWS it is expected that high air preheat levels would be required. Increasing combustion air temperature can improve ignition stability by providing more heat energy to the ignition zone where it is needed to evaporate the water and ignite the coal particles . Individual CWS fuels exhibit different firing characteristics at a given air preheat level. Generally a nominal value of 500°F (260°C) or more air preheat level for CWS firing could be recommended. Burn tests in Reference 2 for an almost identical fuel to CARBOGEL, have shown that sustained ignition could be had using a low air temperature of 95°F (35°C). This stability criteria will vary with burner/atomizer characteristics and amount of furnace absorption which will affect flame temperature. More complete combustion can be had with high air preheat. Low air preheat levels will cause carbon loss to increase and as a result boiler efficiency can drop substantially.

AIR PREHEAT AND ASSOCIATED EQUIPMENT

Air preheat equipment for this unit consists of a Ljungstrom regenerative air heater and a Unifin steam coil airheater. It is expected that at the derated load of 32% MCR an air temperature of 435°F (224°C)leaving the Ljungstrom can be expected. This will require the SCAH to be on raising incoming 80°F (27°C) air to 130°F (54°C). Minimum cold end temperature for corrosion protection should be maintained above approximately 240°F (116°C) for oil firing which has a higher sulphur content than the CWS. Table 3 summarizes airheater performance.

TABLE 3

	Oil Firing 100% MCR	CWS Firing 32% MCR
Air to boiler (lb/hr)	202670	71000
Gas Weight to AH (lb/hr)	221960	82800
Leakage Air To Gas (lb/hr)	38200	15420
Ambient Air Temp. (°F)	80	80
Air Temp. Lvg. SCAH (°F)	80	130
Air Temp. Lvg. AH (°F)	404	435
Gas Temp. to AH (°F)	569	535
Gas Temp. Lvg.AH (°F)	294	280
Air Side Resistance (in.w.g.)	3.4	0.57
Gas Side Resistance (in. w.g.)	4.4	0.83

FANS

This unit is presently set up for pressurized firing using a Howden Forced Draft Fan. The existing fan uses variable intake vanes and will be capable of operating at the reduced flows, with sufficient static head available (NOTE: 3.0 in. (76.2 mm) w.g. was allowed for burner/windbox drop).

The firing of CWS will require the unit to be set up for balanced draft operation. Static head requirements of the ID fan can be set when details of the baghouse filter and associated flues are known.

The following FD Fan information is provided.

F.D. Fan
Pressurized Oil Firing
(Existing)

Air Flow to A.H.	219800 pph
Static Pressure Required	14.38 in. w.g.
Air Temperature	80°F
Balance Draft CWS 32% MCR	
Air Flow to A.H.	85420 pph
Static Pressure Required	4.2 in. w.g.
Air Temperature	80°F

SOOTBLOWERS

Existing sootblowing equipment consists of 6 G9B type lance blowers located in the generating bank, and 2 IK type retractable blowers located in the cavity between the secondary and primary superheaters. The suitability requirements of these existing blowers change, because the CWS is considered an abrasive fuel and oil is considered non-abrasive.

The 6 G9B blowers located in the generating bank are deemed acceptable for the firing of CWS at the maximum allowable evaporation rates encountered for the existing boiler configuration.

The 2 IK blowers located in the superheater cavity have been determined to be less than acceptable. B&W standards recommend that IK blowers are not suitable for cleaning tube banks with 1 inch face to face clearance while blowing against the gas flow. Further it is recommended that the downstream bank which is the primary superheater have a maximum bank depth of 2.5 feet (1.13m). The actual depth of the primary is 4 feet (1.81m). It is quite possible that CWS firing at the derated loads could cause excessive fouling of the superheater. This would have an adverse effect on steam temperature and possibly gas velocity.

SOOTBLOWERS (cont'd.)

It is further recommend that a wall blower per side such as a short retractable IR blower be installed 10 feet (4.54m)above the top burner centreline at a point midway between the screen and front wall.

EROSION

Metal loss due to erosion is proportional to the total ash quantity passing through the boiler and an exponential function of flue gas velocity. Since the total ash is fixed for a given fuel, limiting flue gas velocities to acceptable levels is the method used to ensure minimal erosion. Typically flue gas velocities in the neighbourhood of 100-125 ft/sec. (45.4 - 56.7 m/s) are permitted on oil firing. The CARBOGEL fuel should have a maximum allowable velocity of 65 ft./sec.(29.5 m/s). Actual gas velocity at the derated 32% load firing CWS is only about 15 ft./sec. (6.8 m/s), as such erosion through the boiler should not be a problem.

BOILER PERFORMANCE WITH ALTERNATE SUPERHEATER AND SCREEN

In an effort to reduce the severity of operating deration, an alternative superheater/screen can be installed. The suggested superheater shown in Figure 6 is significantly different than the existing. As mentioned the major restriction on the existing superheater is tight tube side clearances. The alternative superheater has a side spacing of 6 inches (152.4 mm), up 3 (76.2 mm) inches from existing. The steam flow path and bank geometry is shown in Figures 7 & 8. The furnace screen is to be changed to 3 staggered rows on 9 inch (228.6 mm) side spacing, versus the existing 2 row in line on 6 inch (152.4 mmk) side spacing.

The alternative superheater has allowed the boiler to achieve 57% MCR while firing CWS. This limit has been set by the maximum allowable FEGT, which for 3 inch (76.2 mm) tubes on 9 inch (228.6 mm) centres is 1940^{o}F (1060^{o}C). The gas temperature drop through the screen is just sufficient to meet the maximum allowable gas temperature entering the secondary superheater. Essentially this configuration of screen/superheater will allow the boiler to achieve its maximum potential for firing CWS, without modifying furnace and generating bank surface.

Table 4 shows the comparison in overall performance for the existing and alternative superheater.

TABLE 4

	Output (%)			
	Existing Unit		Modified Unit	
	Oil	CWS	Oil	CWS
Maximum Load Attainable (as a %of MCR Oil)	100	32	100	57
Minimum Load To Maintain Steam Temp. of 900°F	30	30	46	38

PREDICTED PERFORMANCE
COAL-WATER SLURRY OPERATION

Surface	Existing Surface (32%MCR)	Alternate (57% MCR)
Steam Flow 10^3 (lb/hr)	60.8	108.3
Heat Available 10^3 (Btu/hr.ft^2)	79.7	142.1
% Excess Air @ Boiler Outlet	22	20
Quantities 10^3 (lb/hr)		
Fuel Burned (CWS)	7.74	13.78
Air @ A.H. Outlet	71.0	126.4
Gas To A.H.	82.8	145.2
Pressures		
Drum	885	
S/Htr. Outlet	879	879
Feedwater	931	931
Temperatures		
Steam @ Shtr. Outlet	900	900
Feedwater	345	345
Air Lvg. A.H.	437	435
Air Lvg. SCAH	130	130
Gas To A.H.	538	550
Heat Losses (%)		
Dry Gas Loss	3.514	3.413
Water From Fuel Loss	6.797	6.791
Moisture In Air Loss	0.088	0.086
Unburned Comb. Loss	2.500	2.500
Radiation Loss	0.619	0.657
Mfg. Margin	1.500	1.500
Total Losses	15.018	14.95
Efficiency	84.98	85.05

APPENDICES

FIG. 1

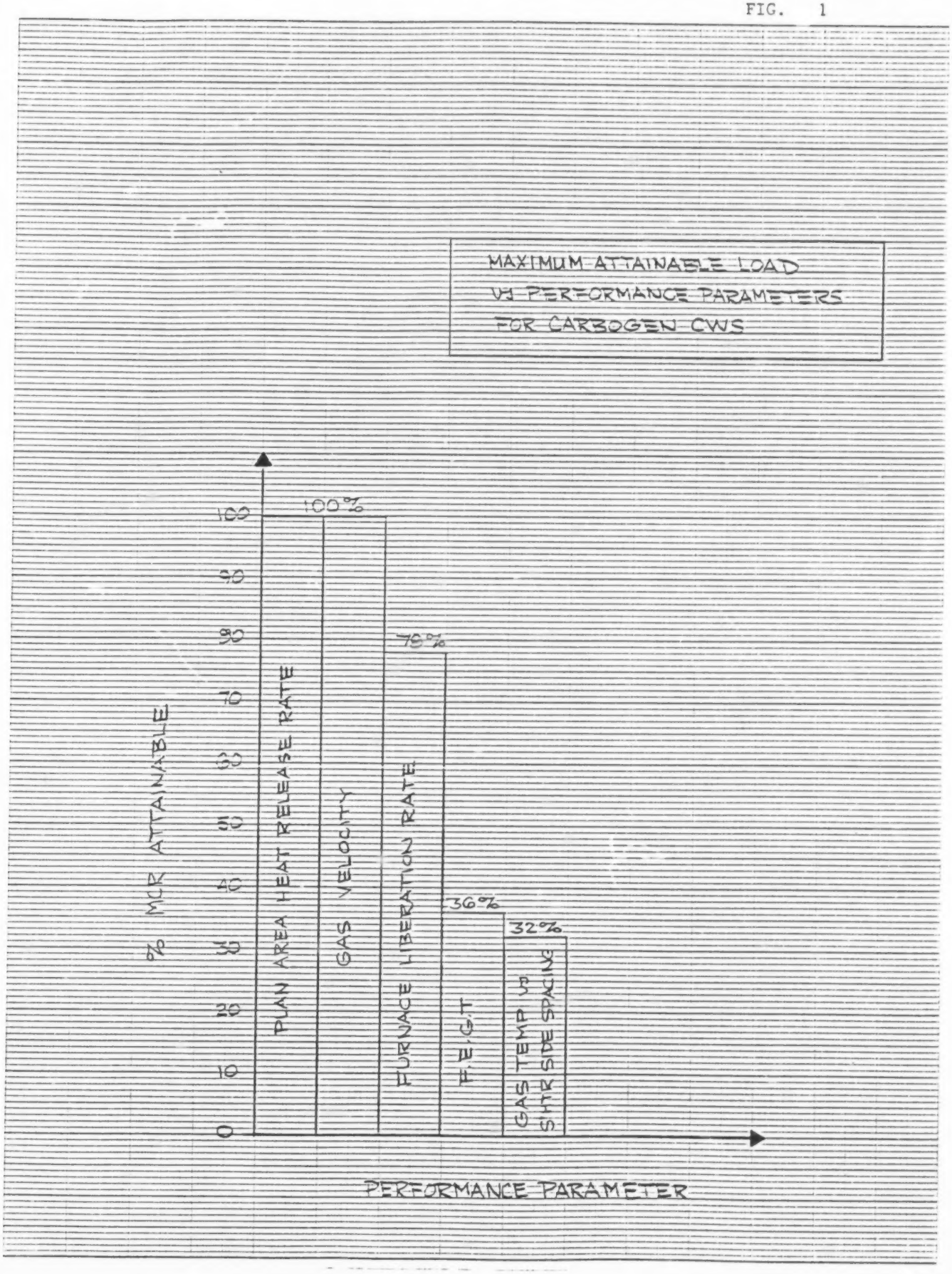
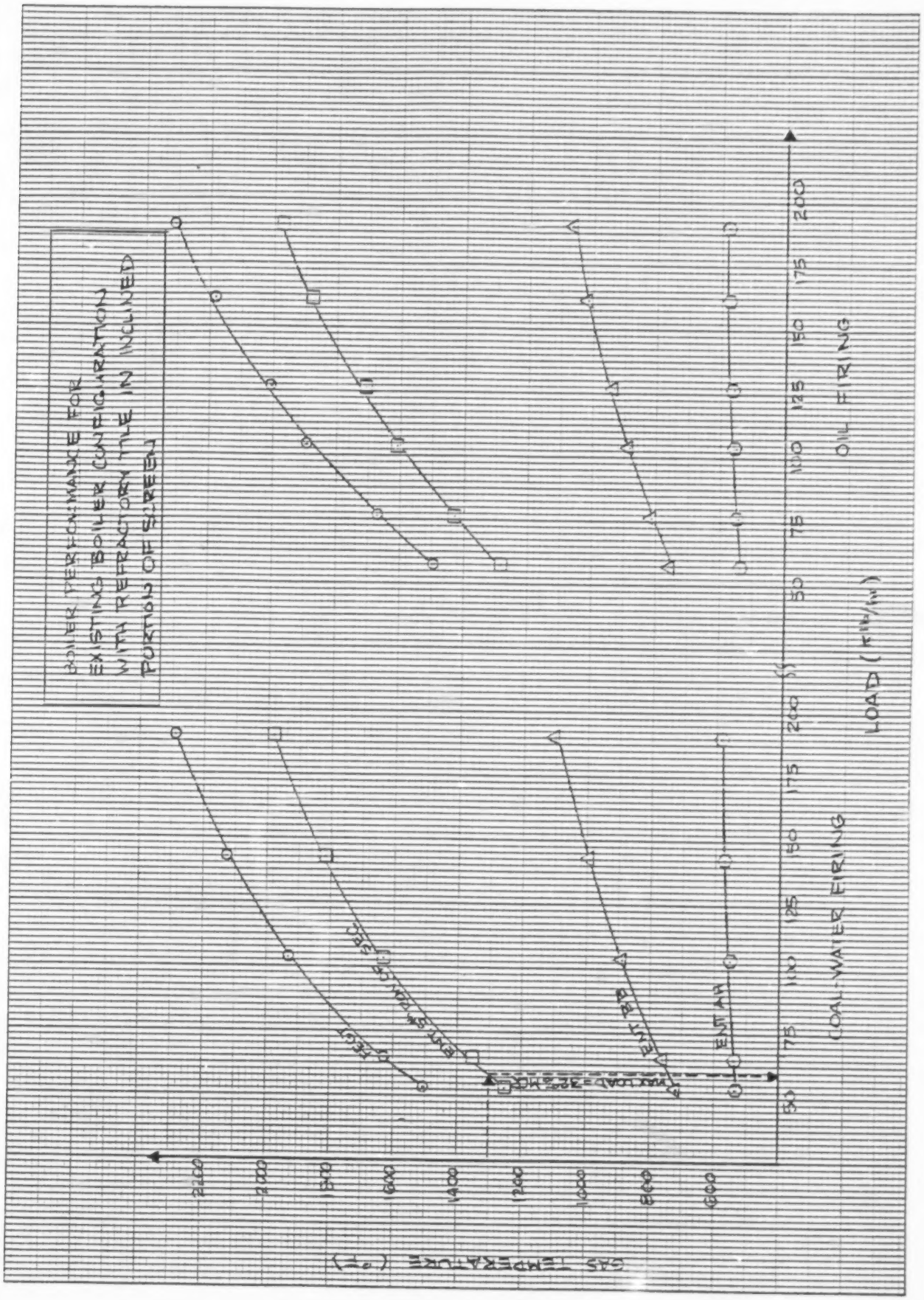

MAXIMUM ATTAINABLE LOAD
VS PERFORMANCE PARAMETERS
FOR CARBOGEN CWS
% MCR ATTAINABLE
100
90
80
70
60
50
40
30
20
10
0
100%
70%
36%
32%
PLAN AREA HEAT RELEASE RATE
GAS VELOCITY
FURNACE LIBERATION RATE
F.E.G.T
GAS TEMP UP
SITR SIDE SPACING
PERFORMANCE PARAMETER

FIG. 2


POWER PERFORMANCE FOR EXISTING BOILER CONFIGURATION WITH REFRACTORY TILE IN PORTION OF SCREEN
INCLINED
OIL FIRING
COAL-WATER FIRING
LOAD (MW/Hr)
GAS TEMPERATURE (°F)
MAX LOAD = 325 MW
DESIGN
EXISTING
EXISTING
50
75
100
125
150
175
200
2200
2000
1800
1600
1400
1200
1000
800
600

K&E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

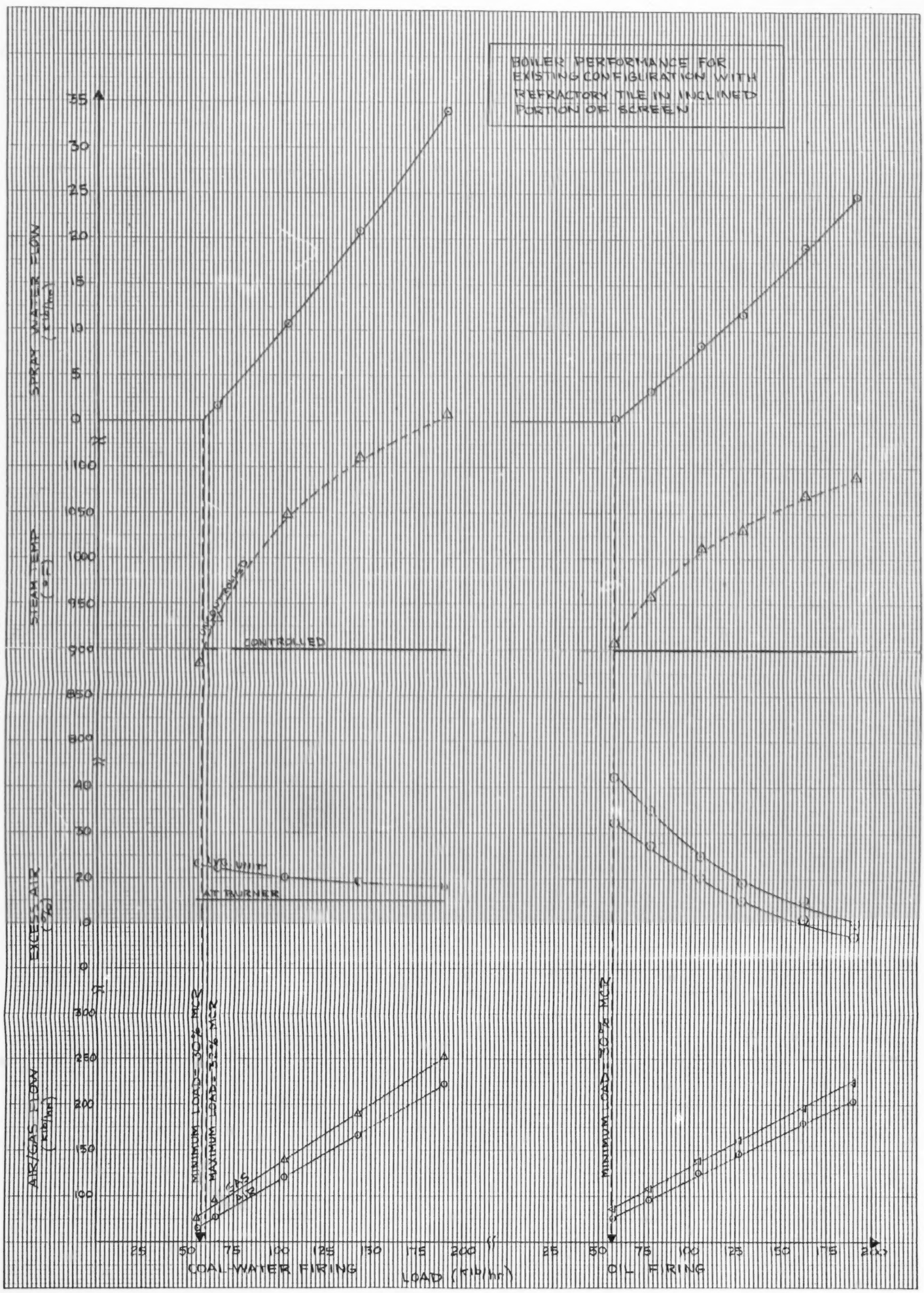
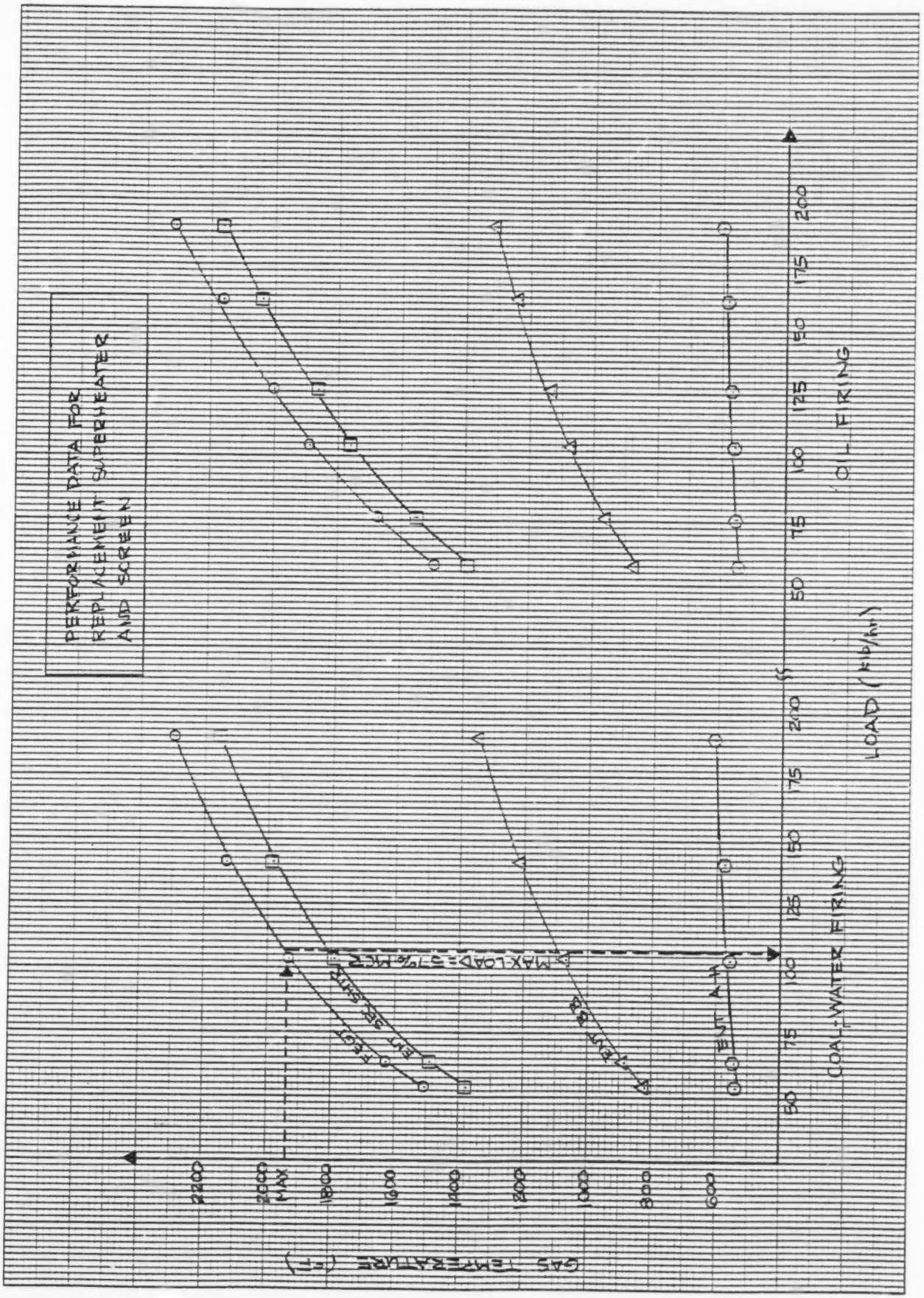


FIG. 3

FIG. 4


PERFORMANCE DATA FOR
REPLACEMENT SUPERHEATER
AND SCREEN
GAS TEMPERATURE (°F)
2200
2000 MAX
1800
1600
1400
1200
1000
800
600
LOAD (kpph)
50
75
100
125
150
175
200
225
250
COAL-WATER FIRING
OIL FIRING
MAX LOAD = 370 MCF
AS-LEFT SUPERHEATER
AS-LEFT SUPERHEATER
AS-LEFT A-H
AS-LEFT A-H

K·E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

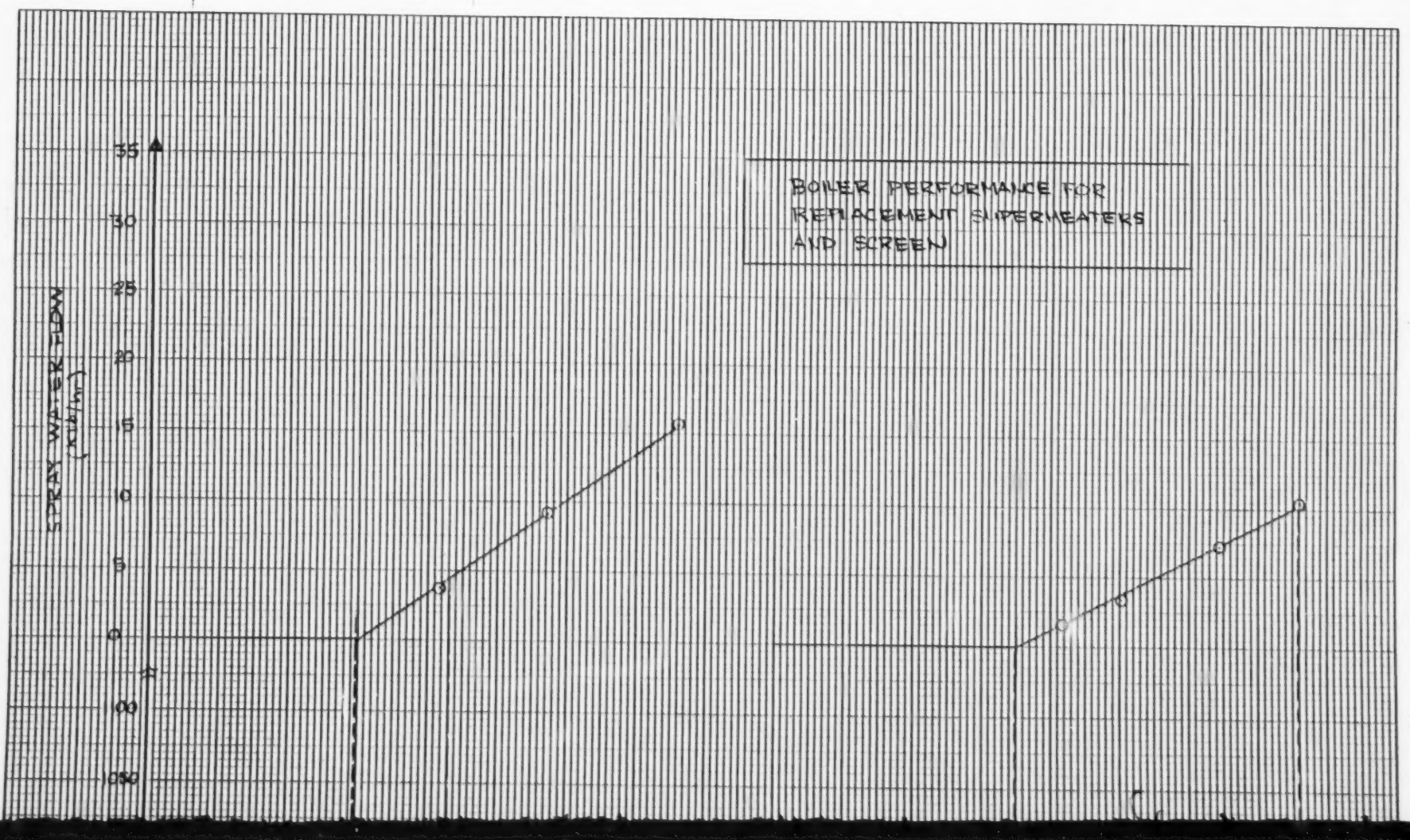
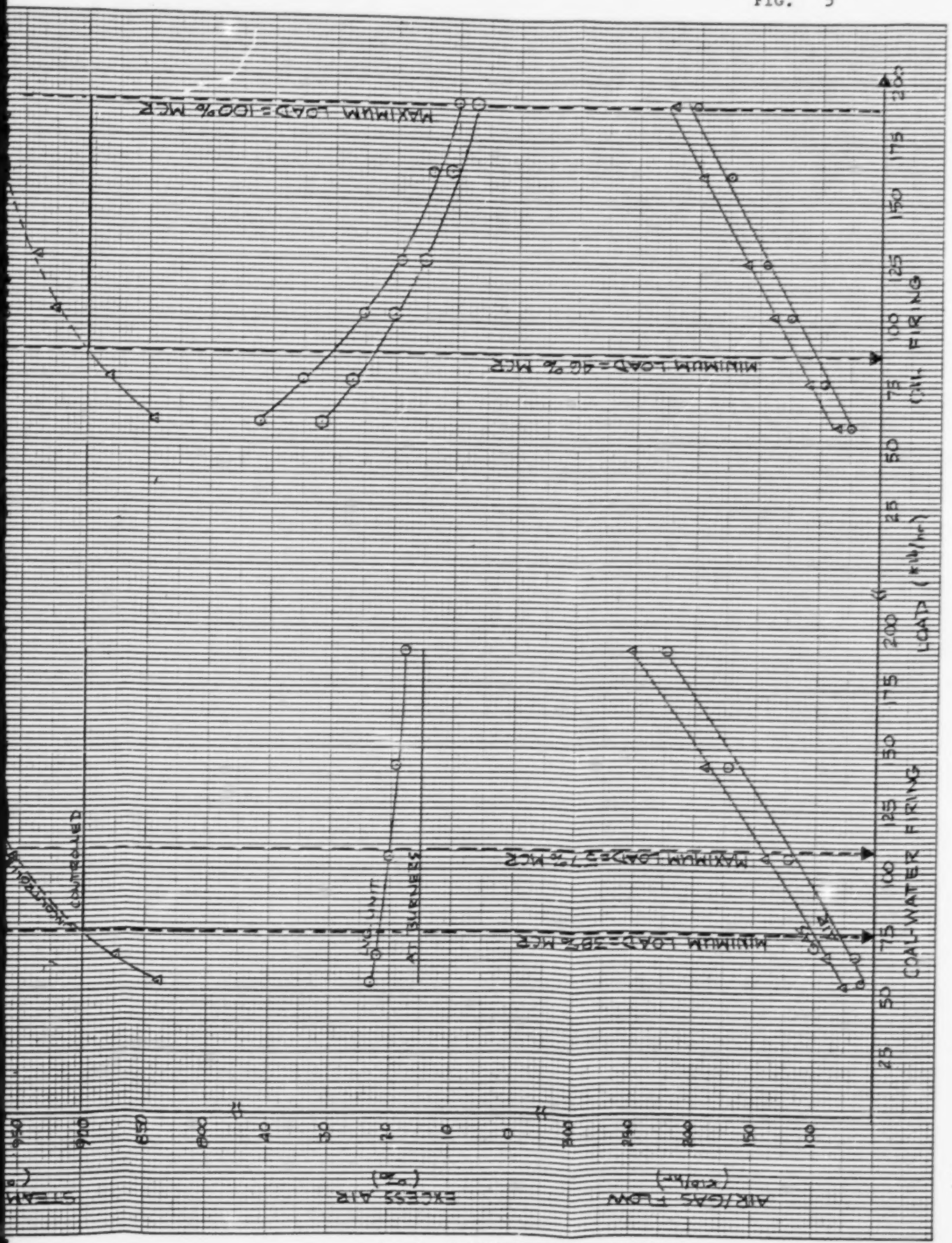
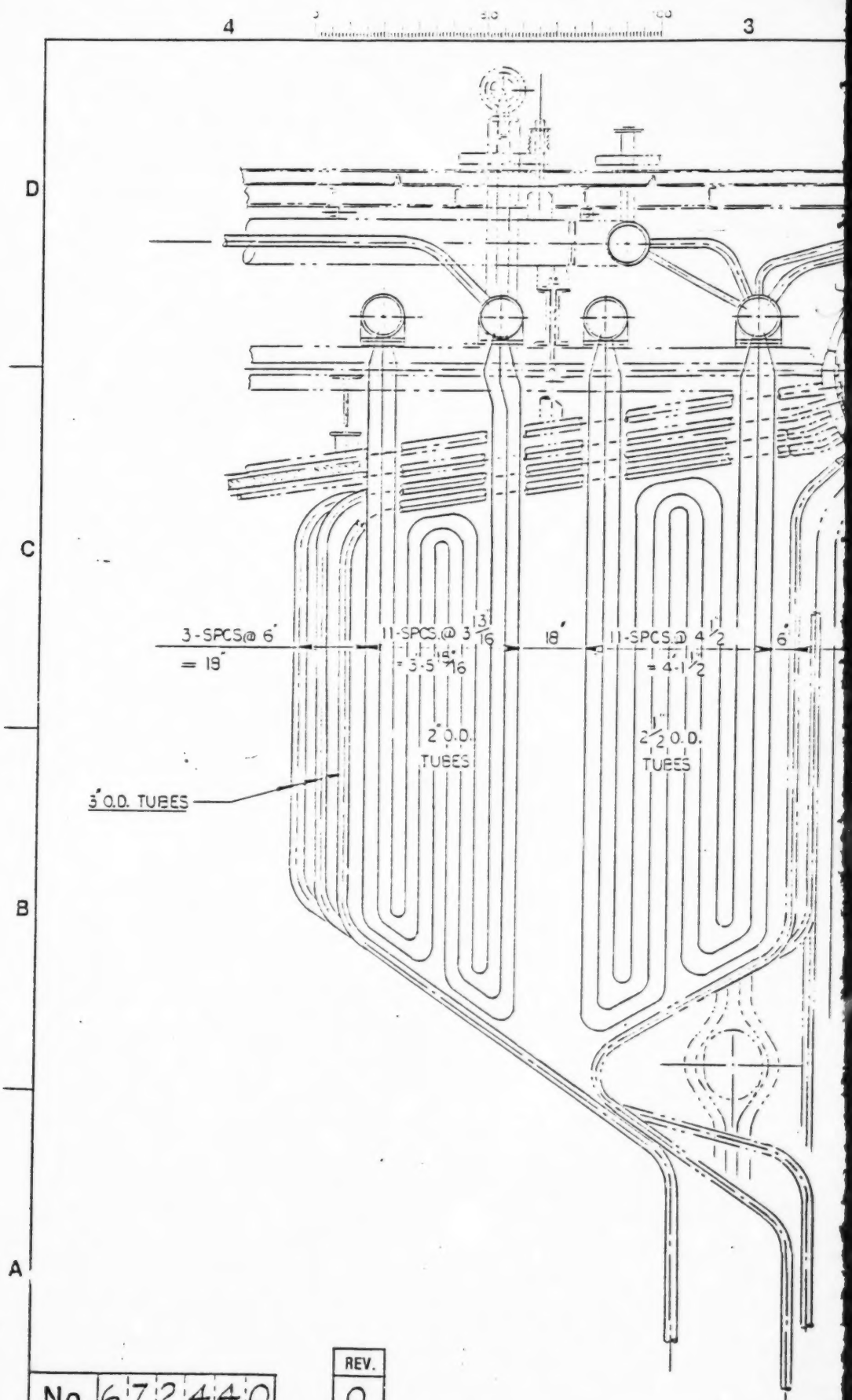


FIG. 5


MAXIMUM LOAD = 100% MCR
MINIMUM LOAD = 46 % MCR
MAXIMUM LOAD = 37½ MCR
MINIMUM LOAD = 28½ MCR
COAL-WATER FIRING
CONT. FIRING
LOAD (MW)
AIR/GAS FLOW
EXCESS AIR
STEAM
BURNERS



No.	6	7	2	4	4	0

REV.
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4

3

REV.	DESCRIPTION	LOC.	BY	DATE	APP.

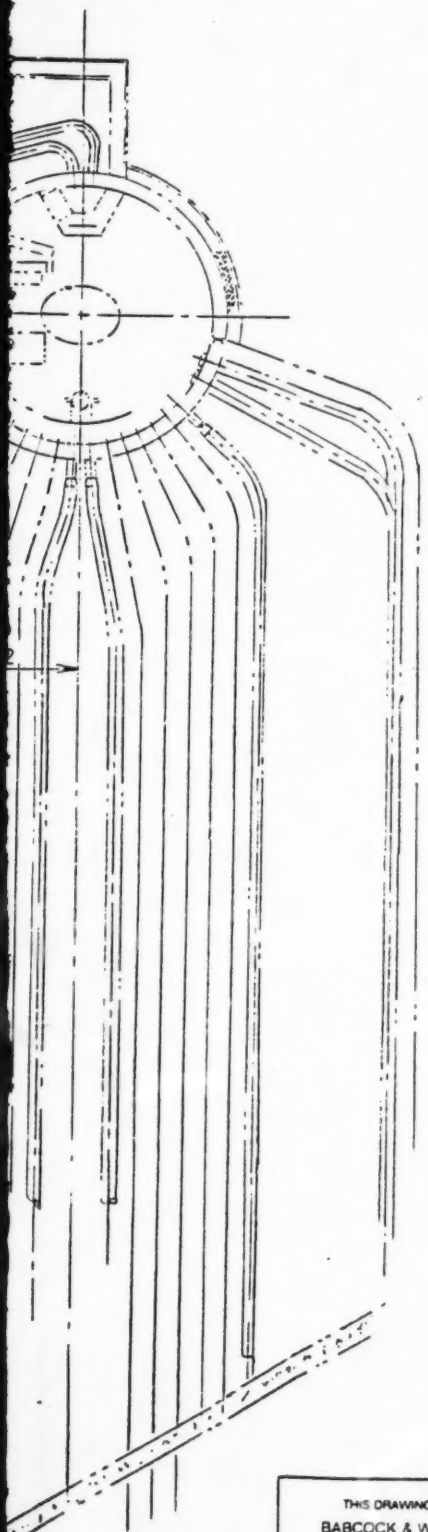

FIG 6

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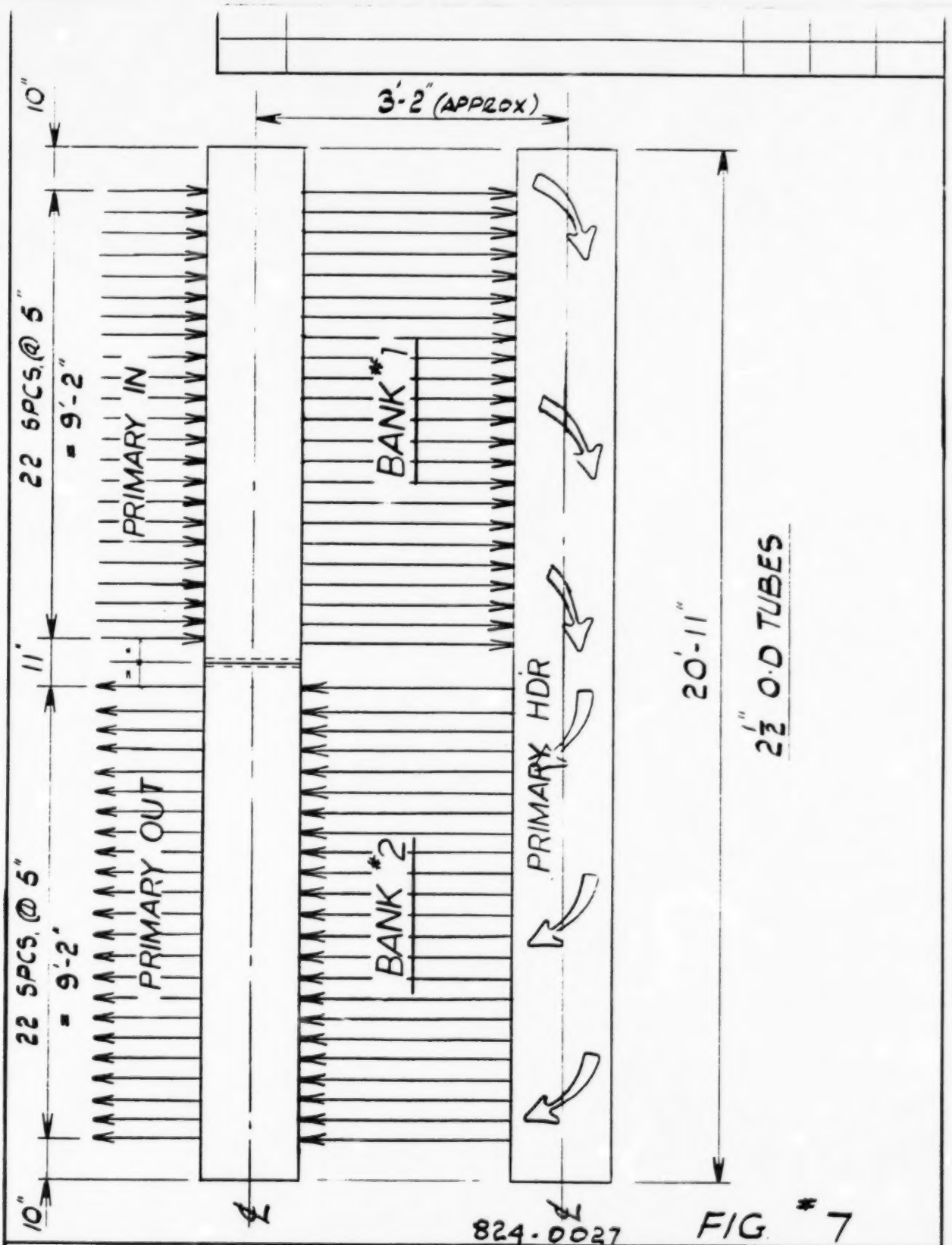
Babcock & Wilcox Canada Ltd., Cambridge, Ontario.

EQUIPMENT ALTERNATE PRIMARY & SECONDARY SUPERHEATER ARRGT.

CUSTOMER MARITIME ELECTRIC CO. LTD CHARLOTTETOWN P.E.I.

DRAWN J.C. CH'K. APP. 824-0027 REV.

SCALE 1/2" = 1'-0" DATE Dec. 2. 85 NO. 6 7 2 4 4 0 0



Babcock & Wilcox Canada Ltd., Cambridge, Ontario.

EQUIPMENT ALTERNATE PRIMARY SUPERHEATER SCHEMATIC ARRG'T

CUSTOMER MARITIME ELECTRIC CO. LTD.

SCALE ~ DRAWN JE CH'K DATE Dec 2 85 NO

APF	REV.
269696	0

K & E 191253

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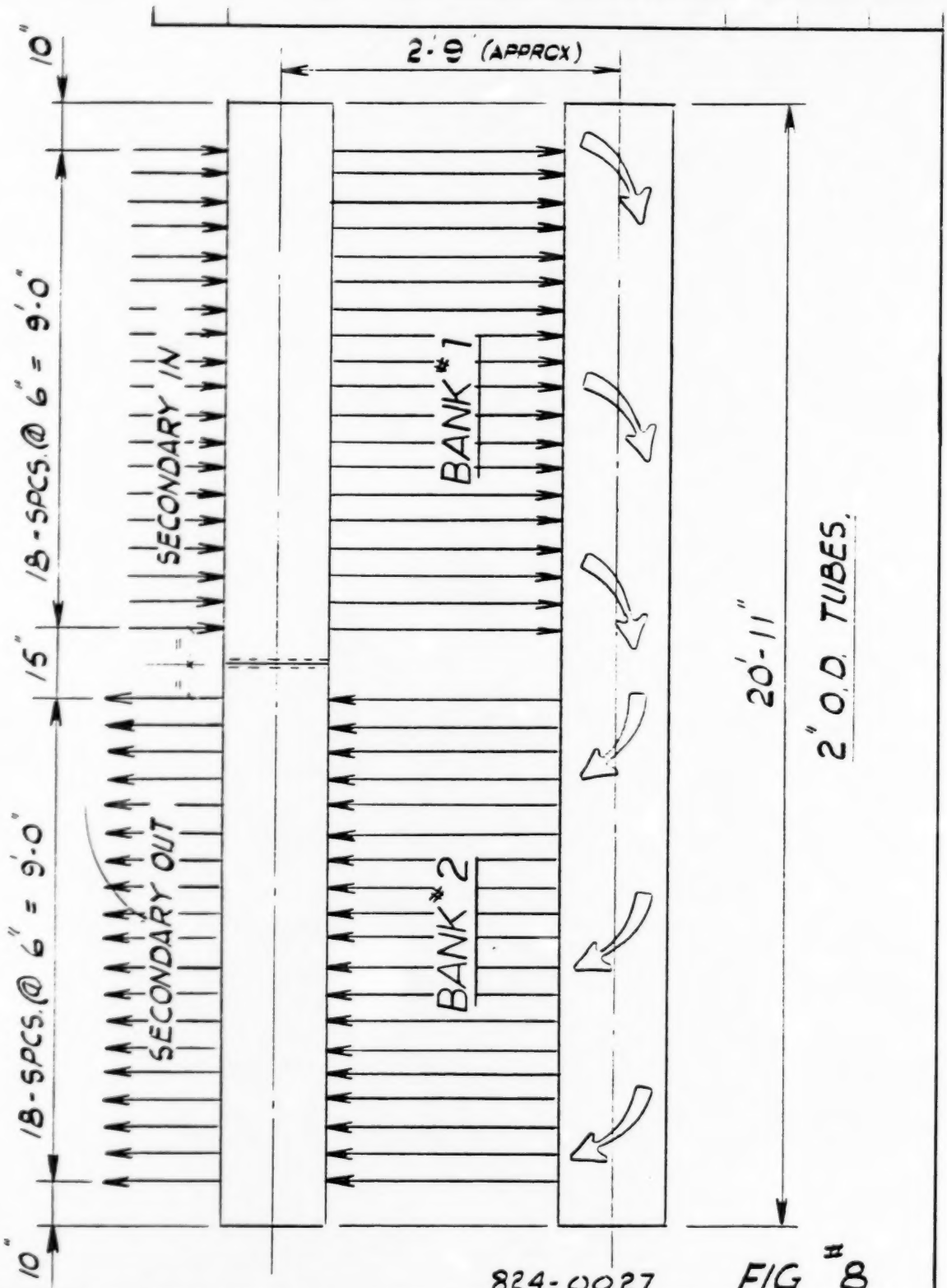

824-0027 FIG # 8

Babcock & Wilcox Canada Ltd., Cambridge, Ontario.

EQUIPMENT ALTERNATE SECONDARY SUPERHEATER SCHEMATIC ARRG'T

CUSTOMER MARITIME ELECTRIC CO. LTD. P.E.I

SCALE — DRAWN JC CH'K DATE DEC. 2, 85.

APP	REV.
269697	0

K & E 191253

A4

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